# (12) EUROPEAN PATENT APPLICATION

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(54) METHOD FOR EXECUTING A PROGRAM AND SYSTEM THEREFOR.

(57) In a system wherein a program on an external memory medium (1) is loaded into a memory (3) and then a processing unit (4) executes a desired process according to the loaded program, a method for executing a program and a system therefor which prevent a miscopied program from being executed. A code in addition to the program is stored in the external memory medium (1) and the code is read out when loaded in to the memory (3) and compared with a special code preset for the system to judge whether or not the program can be executed.

Fig. 1
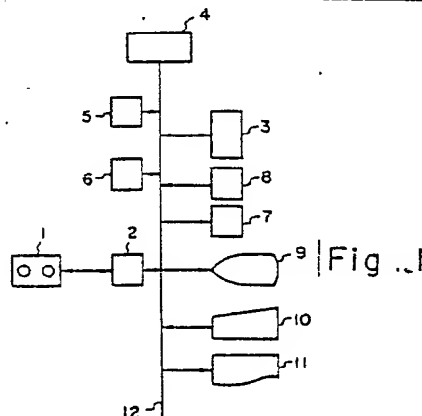
EP 0 067 875 A1

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TITLE MODIFIED see front page

SPECIFICATION

## METHOD OF AND SYSTEM FOR EXECUTING PROGRAMS

### Field of Art

The present invention relates to a method of

5 executing a program capable of preventing the program from

being executed when the program loaded from an external

storage medium is one which has been copied unjustly, as well

as a system for carrying out the method. More particularly,

the invention is concerned with a method of and system for

10 executing a program suitable for use in a data forming

apparatus for numerical control.

### Background Art

In general, an NC ( numerical control ) machine tool

is a machine which operates in accordance with instructions

15 programmed beforehand to machine a workpiece into a desired

shape. More specifically, an NC tape is formed by punching

a tape in accordance with predetermined rules using various

numerical information such as numerical values shown in the

drawings of the product to be obtained, as well as various

20 numerical information concerning the machining conditions

such as feed speed. The machining of the workpiece is

conducted by reading various instructions from the NC tape

loaded in the NC apparatus and then executing the instructions.

The preparation of the NC tape, which is usually made by punching

25 requires considerable experience and time. To obviate this

problem, recently, such an automatic NC tape making apparatus

has been developed as adapted to automatically form the tape

in accordance with input information. The automatic NC

tape making apparatus incorporates various devices such as

permits a prompt and correct preparation of the NC tape advantageously.   The automatic NC tape making apparatus has a computer incorporating a memory which stores the software, i.e. the program, for making the NC tape.

5          Different types of software are used for different forms of the machining to be performed, e.g. turning, 2 1/2-dimensional milling, 3-dimensional milling, punching, wire-cut electrospark machining and so forth.   An impractically large storage capacity of the memory will be required and,

10    hence, the cost of the NC tape making apparatus will be raised undesirably, if the memory has to store the software for all forms of machining.   From the standpoint of the user, only few users require such a large capacity memory as to store all kinds of software.   The manufacturers

15    of the automatic NC tape making apparatus, therefore, prepare different magnetic tape cassettes for storing software for different kinds of machining and furnish some of these cassettes in compliance with the user's request.   Namely, the user can purchase only the magnetic tape cassette storing

20    the software in which he is interested.   The user then loads the magnetic tape cassette in the automatic NC tape making apparatus to transfer the software from the magnetic tape cassette to the memory incorporated in the automatic NC tape making apparatus thereby to store the same in the

25    memory.. It is thus possible to form NC tapes such as an NC tape for turning, milling and so forth.

          This magnetic tape cassette has a wide applicability and can be copied without substantial difficulty.
Therefore, the manufacturer of the automatic NC tape making

30    apparatus, who has made a heavy investment in developing

the software, will be seriously damaged if the user who has purchased the magnetic tape cassette makes copies of the software and sells them unjustly or other users themselves make copies of the software to save the money for

5    purchasing the magnetic tape cassette which is generally expensive.    The manufacturer, therefore, is enforced to take suitable countermeasures for unjust copying of the software (program) or unauthorized use of the copy of the program.

10          Accordingly, an object of the invention is to provide a program executing method and a program executing system capable of prohibiting the use of the software stored in a storage medium such as a magnetic tape cassette produced through unjust copying.

15          Another object of the invention is to provide a program executing method and a program executing system in which an external storage medium annexed to an apparatus making use of a program is applicable only to this apparatus, while the storage medium or another storage medium which is

20    a copy of the first-mentioned storage medium cannot be used in another apparatus.

          Still another object of the invention is to provide a  program executing method and a program executing system in which, when an external storage medium is used for the

25    first time in an apparatus, the external storage medium becomes usable only in this apparatus.

Disclosure of the Invention

          Accoding to the program executing method and system of the invention, an external storage medium for storing

30    the program stores also predetermined code data.    When

the external storage medium is loaded in an apparatus to
store the program in the memory incorporated by the
apparatus, the code data carried by the external storage
medium is compared with the peculiar code set in the
apparatus, and a judgement is made as to whether the loaded
program is executable by the apparatus, in accordance with
the result of the comparison.   The program having any code
not conforming to the code peculiar to the apparatus cannot
be executed by this apparatus and, therefore, the unjust
copying of the program becomes meaningless.   A protection
of the program is thus attained.

      According to the method and system of the invention,
when the code data stored in the storage medium is a virgin
code, the code data is forcibly rewritten into the code
peculiar to an apparatus, when the storage medium is used
for the first time in this apparatus.   As a result, the
storage medium becomes usable only in this apparatus
exclusively, so that any wrongful use of the storage medium
in another apparatus, as well as application of the copies
to another apparatus, is prohibited effectively.   This
protective function is imparted by the apparatus itself.

Brief Description of the Drawings

      Fig. 1 is a block diagram of an automatic NC tape
making apparatus in accordance with the invention;

      Fig. 2 shows the concept of the content of the MT
employed by the method and system of the invention; and

      Fig. 3 is a flow chart for explaining an embodiment
of the invention.

The Best Mode for Carrying Out the Invention

      Fig. 1 is a block diagram of an automatic NC tape

making apparatus for carrying out the present invention. A reference numeral 1 designates a magnectic tape cassette (referred to as " MT " , hereinunder) storing a program for making an NC tape.   AS shown in Fig. 2, the MT 1 has a plurality of recording regions: namely, a loader recording region 1a, main recording region 1b and a code recording region 1c which are disposed from the head to the tail in the mentioned order.   The loader recording region 1a stores a loading program, while the main recoding region 1b stores a program, necessary for making the NC tape.   The code recoding region 1c stores a code peculiar to the automatic NC tape making apparatus which makes use of this MT or, alternatively, a generic code such as all " 0 ".   A reference numeral 2 designates a reading/writting device adapted to be detachbly loaded with the MT 1 to read information from MT 1 or to write the above-mentioned peculiar code in the MT 1.   A reference numeral 3 designates a semiconductor memory composed of a random access memory (RAM) and adapted to store information such as NC tape making program read by reading/writing device from the MT 1, result of computation, input data and so forth.   A reference numeral 4 designates a processing device such as a microprocessor, 5 denotes a read-only memory (ROM) for storing the control program and 6 denotes a code setting device constituted by, for example, a nonvolatile memory, code setting switch or the like and adapted to set or store the code peculiar to the NC tape making apparatus.   This peculiar code may be stored beforehand in a predetermined adress in the ROM 5.   A reference numeral 7 denotes a tape puncher, 8 denotes a

paper tape reader, 9 denotes a graphic display, 10 denotes
a key board for inputting numerical data and commands, and
11 denotes a printer.   A data bus is designated at a
reference numeral 12.

An explanation will be made hereinunder as to how an
NC tape is made by means of a virgin MT purchased from the
manufacturer, with specific reference to Fig. 3.

The code recording region 1c of the MT has, for
example, 8 (eight) bits.   A generic code consisting of
bits $b_0$ to $b_7$ each bearing "0" is stored in this MT as a
virgin code.

(1)    First of all, a start switch (not shown) in the key
board 10 of the automatic NC tape making apparatus is pressed.
As a result, a bootstrap signal (atarting signal) is
delivered to the processing device 4 through the data bus
12.   Subsequently, the loader (loading program) written
in the loader recording region 1a is read by the reading/
writting device 2 in accordance with the bootstrap signal,
and is stored in the semiconductor memory 3 through the data
bus 12.   As this loader is executed by the processing device
4, the NC tape making  program is read out from the main
recording region 1b of the MT 1 and is stored in the
semiconductor memory 3.   Subsequently, the code stored in
the code recording region 1c of the MT 1 is read by the
processing device 4.

(2)    The processing device 4 then judges the nature of
this code.

(3)    If this code is the generic code (virgin code), the
processing device 4 reads the code peculiar to the automatic
NC tape making apparatus from the code setting device 6 and

writes the same in the code recording region 1c of the MT 1.
Namely, the generic code which has been initially stored
is erased and the specific code stored in the code setting
device 6 is written in place of the erased code.

5    (4)    As the foregoing steps are completed, the processing
device 4 is ready for the making of the NC tape in accordance
with the NC tape making program now stored in the
semiconductor memory 3.

        AS stated before, the code peculiar to the automatic

10   NC tape making apparatus in which the MT 1 is used for the
first time is written in the code recording region 1c of
the MT 1.    Therefore, the MT 1 is usable only in this
apparatus exclusively, for the reasons stated later.

        An explanation will be made hereinunder as to how

15   the automatic NC tape making apparatus operates when it is
loaded with the exclusive MT.

        As the start switch of the key board 10 is pressed
after mounting this exclusive MT on the reading/writing
device 2, a step similar to the aforementioned step 1 is

20   taken and then a judgement is made as to whether the code
stored in the code recording region 1c of the MT 1 is the
generic code or not, as in the step (2) mentioned before.

    (5)    If the code thus read out is judged by the processing
device 4 as not being the generic code, the peculiar code

25   is read without delay from the code setting device 6 and is
compared by the processing device 4 with the code read out
from the MT 1.

    (6)    If the code read out from the MT 1 coincides with
the peculiar code read out from the code setting device 6,

30   this MT is accepted as the usable tape so that the NC tape is

made using the progrem stored in this MT.

Assuming that an MT annexed to another automatic NC
tape making apparatus or a copy of the same is used in this
automatic NC tape making apparatus mentioned above, the MT
is not accepted because the code stored in the MT does not
coincide with the peculiar code stored in the code setting
device 6.

(6´)    In consequence, a discordance signal is issued to
make the automatic NC tape making apparatus inoperative with
the program stored in the MT.

According to the embodiment of the invention described
hereinbefore, the tape making operation by the automatic NC
tape making apparatus is possible only with the MT annexed
to the apparatus or a virgin MT (cahnged into MT annexed to
the apparatus once used in the apparatus).    It is, therefore,
meanlingless to make copies of the MT content.    For storing
the peculiar code in the ROM 5, it is necessary to write a
control program including the peculiar code in each of the
automatic NC tape making apparatus in the course of the
production of the apparatus.    Such work is extremely
troublesome.    To obviate this trouble, it is suggested to
prepare, for example, 10 (ten) kinds of ROM tapes or master
ROMs and, in the course of production of the automatic NC
tape making apparatus, the content of a selected one of 10
ROM tapes or 10 master ROMs is written in the ROM 5 (master
program memory) in the apparatus.    By taking such a measure,
the chance of applicability of a copy MT to another apparatus
is considerably decreased to achieve the above mentioned    -
purpose.

Although a magnetic tape cassette is used as the MT

in the described embodiment, it will be clear to those skilled in the art that the magnetic tape cassette can be substituted by other types of recording medium such as a magnetic bubble memory, floppy disc or the like. Needless to say, the invention is applicable also to any program-controlled apparatus other than the described NC tape making apparatus.

As has been described in detail hereinbefore, according to the invention, the automatic NC tape making apparatus can operate only with the MT which is annexed to the apparatus from the beginning, i.e. from the time of shipment, or a virgin MT (changed into an MT usable exclusively for the apparatus once it is used in the apparatus), and the MT produced by copying the original MT cannot be used in other automatic tape making apparatus. The copying of the MT, therefore, is quite meaningless and useless, so that the unjust use of the developed software is effectively prohibited. The production of the MTs by the manufacturer can be made easily because it suffices only to store the generic code in the MTs. This can be made simply by making duplicates of the MTs, without requiring the manufacture of independent MTs in large quantity.

Industrial Applicability

According to the invention, it is possible to invalidate the unjust copying of the program and, hence, to protect the program, in such a system that various application forms are prepared in the form of contents of external storage media in order to make the apparatus including a processing unit execute various kinds of processing to permit the user to select and purchase only

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the external storage medium storing the program necessary
for executing the desired processing.
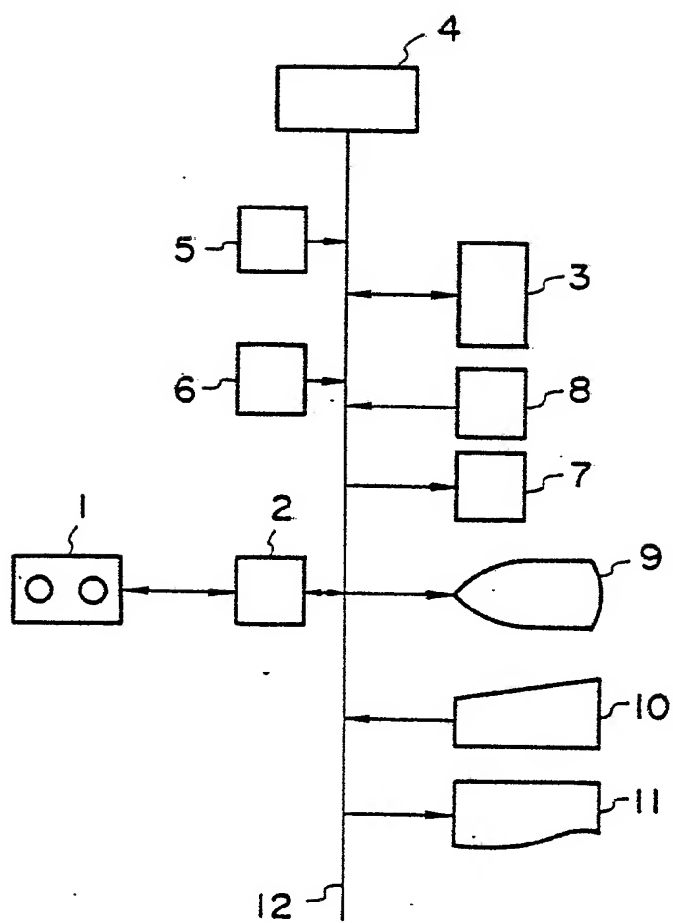
What is Claimed is:

1.      A method of executing a program in which a program
is read out from a storage medium detachably mounted on an
apparatus and stored in an internal memory of the apparatus,
and in which a processing unit incorporated in the apparatus
executes predetermined processing in accordance with program
data stored in said internal memory, an improvement which
comprises the steps of reading program data in said
storage medium and code data; storing the read out program
data and said code data in said internal memory; comparing,
by said processing unit, said code data stored in said
memory with said code data peculiar to said apparatus set
in said apparatus and judging, through the comparison,
whether said program data stored in said memory is executable
by said apparatus.

2.      A method of executing a program according to claim
1, characterized by further comprising the steps of:
discriminating, after the step of storing, whether said
code data is a virgin code, and, when this code is
discriminated as being a virgin code, rewriting said code
data in said storage medium into said peculiar code data
set in said apparatus.

3.      A method of executing a program according to claim
2, wherein said step of judging is conducted when said stored
code data is not virgin code data.

4.      A method of executing a program according to claim
1, wherein said program data is a program for converting the
input data into data for numerical control machining.

5.      A system for executing a program comprising: a
storage medium adapted to be detachably mounted on an

apparatus and storing both program data and code data; means for reading data from said storage medium; means for setting a peculiar code; and a processing unit connected to the reading means and the setting means and adapted to perform processing in accordance with a control program; said processing unit being adapted to compare said code data read from said storage medium and stored in said memory with said peculiar code and to judge, through the comparison, whether said program data read from said storage medium and stored in said memory can be executed by said apparatus.

6.     A system for executing a program according to claim 5, wherein the reading means has a function to write data in said storage medium, and wherein said processing unit is adapted to judge whether the code data read from said storage medium and stored in said memory is a virgin code and, if said code is judged to be a virgin code, to make said reading means rewrite said code data in said storage medium into a peculiar code set by the setting means.

7.     A system for executing a program according to claim 5, characterized by further comprising inputting means for inputting numerical data, and characterized in that said processing unit is adapted to convert the numerical data input by said inputting data into numerical control machining data in accordance with said program data stored in said storage medium.
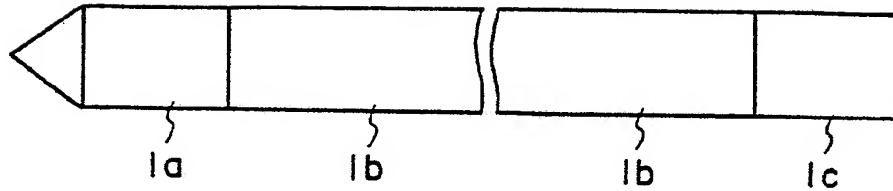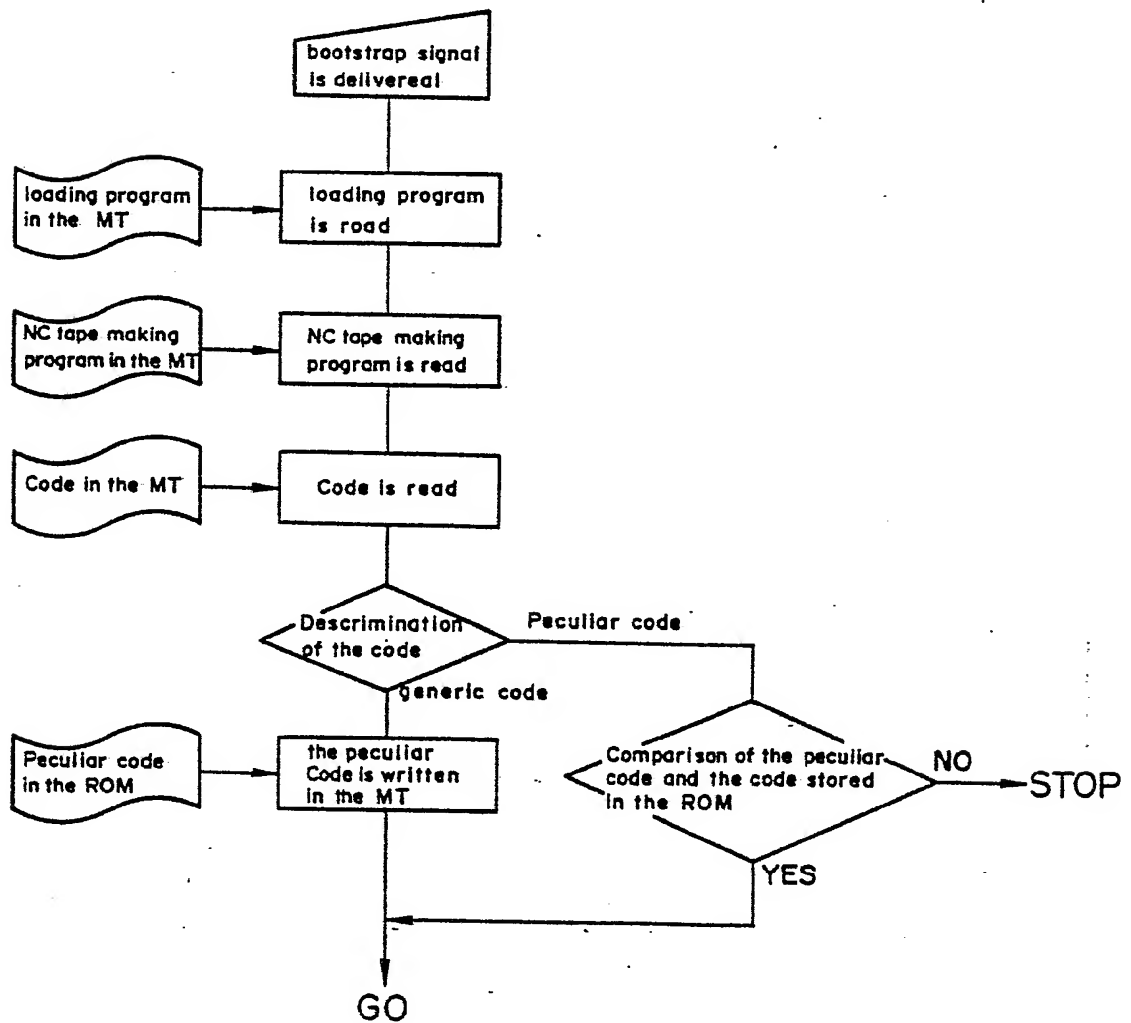
I

# Fig . I

2

# Fig. 2



la          lb          lb          lc

# Fig. 3



bootstrap signal is delivered

loading program in the MT → loading program is road

NC tape making program in the MT → NC tape making program is read

Code in the MT → Code is read

Descrimination of the code — Peculiar code

generic code

Peculiar code in the ROM → the peculiar Code is written in the MT

Comparison of the peculiar code and the code stored in the ROM — NO → STOP

YES

GO

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³

According to International Patent Classification (IPC) or to both National Classification and IPC

Int Cl³   G05B19/405

## II. FIELDS SEARCHED

### Minimum Documentation Searched ⁴

| Classification System | Classification Symbols |
|---|---|
| Int Cl³ | G05B15/00, G05B19/00 <br> G06F 9/06 |

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched ⁵

Jitsuyo Shinan Koho        1926 - 1981
Kokai Jitsuyo Shinan Koho    1971 - 1981

## III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴

| Category * | Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷ | Relevant to Claim No. ¹⁵ |
|---|---|---|
| Y | JP, A, 51-62280 (Osumi Tekkosho Kabushiki Kaisha.) <br><br> 1976-5-29, Page 2, lower left column to page 3, lower portion | |
| Y | JP, A, 49-100478 (Nippon Electric Co., Ltd.) <br><br> 1974-9-24, Page 3 upper portion | |
| | "Y" Document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. | |

* Special categories of cited documents: ¹⁶

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance·

## IV. CERTIFICATION

| Date of the Actual Completion of the International Search ³ | Date of Mailing of this International Search Report ³ |
|---|---|
| December 7, 1981 (07. 12. 81) | December 21, 1981 (21.12.81) |
| International Searching Authority ¹ <br><br> Japanese Patent Office | Signature of Authorized Officer ¹⁰ |